Exploring the Relationship Between Agricultural Marketing Communication and Consumer Attitudes Towards Genetically Modified Organisms

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IMC 501 Section 2: Principles of Integrated Marketing Communication

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November 29, 2023

Agriculture is a cornerstone of human civilization, providing sustenance, shaping economies, and influencing societal well-being. As contemporary agriculture adapts from traditional tactics to withstand a growing global population, the conversation surrounding genetically modified organisms emerges as a scientific dialogue and a pivotal element of public perception.

Genetically modified organisms, a breeding method commonly referred to as GMOs, have exceeded the boundaries of scientific laboratories to become integral components of our global food systems. Genetic modification involves biological organisms (i.e., plants) whose genetic material has been altered using modern genetic engineering techniques. These modifications, achieved by directly manipulating an organism's genes, constitute genetic engineering, commonly abbreviated as GE. This process of genetic modification, GM, involves altering a biological organism's genetic material to introduce desirable traits or eliminate undesirable ones, thereby resulting in desirable growth characteristics, higher yields, or greater plant productivity.

This development prompts a critical exploration: What is the relationship between agricultural marketing communication and consumer attitude towards GMOs? This research question dives into how communication strategies shape how the public perceives and engages with genetically modified foods. First, it is essential to understand the impact of agriculture.

Agriculture is one of the world's largest and most important industries. It sustains life, fuels economies, and is the backbone of food security. It employs over one billion people worldwide and generates about 1.3 trillion dollars to the United States gross domestic product (World Wildlife Fund, n.d.; USDA, 2023). Pastures and cropland occupy around 50 percent of the Earth's habitable land, providing homes and food for most species (World Wildlife Fund,

n.d.). The essence of societal perceptions of sustainability and the health of Earth's future is directly tied to the success and efficiency of agricultural practices. Recognizing the enormous impact of agriculture on our daily lives, the exploration of genetically modified organisms becomes not just a scientific hobby but a legitimate search with implications for the sustenance and prosperity of nations on how to provide necessities with less space and rapidly growing populations.

Why should people care about the relationship between agriculture marketing communication and consumer attitudes? The answer lies in the powerful influence of consumer attitudes on adopting genetically modified foods. Agriculture relies on informed choices and responsible practices. The acceptance or rejection of GMOs is not simply a scientific debate, but a societal choice influenced by marketing and communication strategies. Misperceptions about the safety of GMOs, paired with consumers' values and knowledge about their personal understanding, become challenging barriers to accepting and learning accurate communication (Kim et al., 2018). Understanding this complex relationship is critical for fostering informed public conversations and attitudes, guiding the development of responsible communication strategies, and ensuring the continued sustainability of agriculture.

Through the inquiry of studying the relationship between agricultural marketing communication and consumer attitudes toward food produced with transgenic practices, it is important to not only understand the complex relationship between communication and attitude but also to contribute to a more refined understanding that bridges the gap between science, communication, and the vital role agriculture plays in shaping the trajectory of human civilization.

Background

Evolution and Development of GMO's and Their Impact on Agriculture

The evolution and impact of genetically modified organisms in agriculture respond to the challenge of feeding a growing global population, projected to reach 9.8 billion by 2050 (United Nations, n.d.). The historical narrative, dating back to the 1700s, saw initial steps in manipulating plant traits through traditional crossbreeding methods. In the 1980s, refined genetic engineering techniques emerged, marking the commercialization of GMOs and shaping public perceptions (Siddiqui et al., 2022).

By 2019, approximately 190.4 million hectares around the globe were dedicated to cultivating GM crops, emphasizing the need to understand communication strategies amid their widespread use (Abdul Aziz et al., 2022). Advances in gene editing technologies like CRISPR/Cas9 have further accelerated the development of genetically engineered (GE) crops. These GE crops, instrumental in addressing global food demand and challenges like climate change, raise concerns about consumer health, environmental impact, and ethical considerations (Rose et al., 2020; Hwang & Nam, 2021).

While GM crops offer benefits like resistance to pests and enhanced nutritional content, public concerns include environmental risks, antibiotic resistance, and potential effects on human health. Consumer anxiety about GMOs stems from the perceived inability to control risks (Hwang & Nam, 2021). Ethical considerations revolve around possible harmful effects on human health, contributing to decreased consumption rates (Abdul Aziz et al., 2022; Midtvedt, 2014).

Despite concerns, GM crops covered 190.4 million hectares in 2019, with global acceptance evident in regulatory approvals from 44 countries for 40 GM crops and 509 genetic modification events since January 2022. This includes 41 commercial traits designed for

cultivation, food, and feed (Abdul Aziz et al., 2022). Recent advancements in gene editing technologies, particularly CRISPR/Cas9, continue to shape the future of agriculture and genetically engineered crops (Suldovsky & Akin, 2023; Rose et al., 2020).

Media coverage, initially positive, shifted in the late 1990s, to negatively influencing public apprehension and altering the perception of risks associated with agricultural biotechnology (Brossard & Shanahan, 2003). The proliferation of GM crops emphasizes the need to comprehend the impact of communication strategies on public attitudes, ensuring informed discourse on the safety, risks, and environmental implications of crops produced using GM.

Development of Agricultural Marketing Communication for GMO's

Developing effective agricultural marketing communication campaigns for genetically modified organisms is crucial for shaping public attitudes and fostering acceptance of GM foods. Scientists and communication specialists play key roles in addressing misperceptions surrounding the risks and benefits associated with GMOs (Sleboda & Lagerkvist, 2022). Targeted communication efforts are essential to bridge the knowledge gap related to technology. Increased knowledge about GM foods is consistently linked to a more positive attitude and higher acceptance (Costa-Font et al., 2008; Hossain & Onyang, 2004). However, it is recognized that effective communication must navigate the risk of motivated reasoning triggered by existing beliefs or knowledge (Sleboda & Lagerkvist, 2022).

Previous research on the effectiveness of communication strategies in influencing attitudes toward GM foods yielded mixed results, with some studies reporting no significant changes and others noting unintended shifts toward more negative perceptions (Frewer et al., 1996; Frewer et al., 2003). The ongoing and dynamic nature of agricultural innovation, marked

by introduction of various advanced GM crops into research and development pipelines, emphasizes the need for continuous studies on its influence (Parisi et al., 2016; Kim et al., 2018).

The influence of the marketing-guided "non-GMO" label on public attitudes underscores the need for a comprehensive understanding of factors contributing to GMO rejection, especially in the context of advancing gene editing technologies (Rose et al., 2020). Effective communication in this realm is intertwined with media coverage, shaping perceptions of technology and its societal implications (Rose et al., 2020). Beyond traditional demographic factors, perceived risks play a more substantial role in public acceptation, emphasizing the significance of specific risks and benefits associated with GMOs (Rose et al., 2020).

Consumer attitudes play a vital role in shaping the future of genetic modification in the agro-food sector and have influenced the commercialization of GM foods (Siddiqui et al., 2022). Qualitative research is emphasized to better understand societal concerns within the evolving landscape of agricultural marketing communication (Siddiqui et al., 2022). Factors such as perceived risk, benefit, moral acceptability, demographics, value predispositions, media attention, organizational trust, and individual knowledge are predictors of consumer attitude, with potential risks playing a more prominent role (Rose et al., 2020).

Consumers gather information about GM foods from diverse sources, including the internet, television, radio, newspapers, magazines, scientific papers, and interpersonal communication (Siddiqui et al., 2022). Negative attitudes and low acceptance of GM as a plant breeding technology are often linked to perceptions of high risks and low benefits associated with GM foods (Sleboda & Lagerkvist, 2022). The intertwined relationship between the development of agricultural marketing communication and consumer attitudes toward genetically modified organisms will be explored in-depth.

Literature Review

Overview of Consumer Attitudes Towards GMOs

In exploring the relationship between agricultural marketing communication and consumer attitudes towards food produced using GM breeding practices, it becomes clear that conventional one-way communication strategies from scientists to consumers do not effectively inform and persuade the public about genetically modified foods (Sinemus & Egelhofer, 2007). Many traditional approaches result in negative public attitudes towards GM food products, emphasizing the need to study the perceptions based on trust, knowledge, and values compared to factual scientific data (Sleboda & Lagerkvist, 2022).

Effective communication and marketing in agriculture are crucial to address the prominent lack of public understanding and awareness concerning agricultural biotechnology, particularly genetically engineered food. Achieving a higher level of public trust and understanding is a significant breakthrough, necessitating transparency across various levels, including politics, governments, and industry (Sinemus & Egelhofer, 2007). In the context of agricultural biotechnology, despite the demonstrated benefits, there exists a notable lack of knowledge among the American public regarding GM crops and genetically modified organisms (Phillips & Hallman, 2013). This knowledge gap extends to the prevalence of GM foods in the global food chain, with many consumers being oblivious that such products are readily available on supermarket shelves (Suldovsky & Akin, 2023).

Importance of Agricultural Marketing Communication

The insufficient public knowledge regarding GM as a breeding technology underscores the critical role of effective agricultural communication and marketing strategies. These

strategies are pivotal in bridging the communication gap between the scientific community and the public, providing accurate information about GE foods' benefits, safety, and prevalence. The presented statistics, such as over half of U.S. consumers having little or no knowledge about GE foods, stress the urgency of improving public awareness and attitudes (Phillips & Hallman, 2013).

Agricultural communication and marketing are vital for eliminating misinformation, promoting positive public awareness, and fostering a better understanding of agricultural biotechnology. By addressing these communication gaps, the agricultural sector can build trust, promote informed decision-making, and ensure the acceptance of modern technology associated with modern agricultural state-of-the-art breeding to produce more food for a growing global population.

Key Factors Influencing Consumer Attitudes Towards GMOs

Trust

Trust is one of the most important factors influencing consumer attitudes toward genetically modified organisms and significantly shaping agricultural marketing communication strategies. The media’s misconstrued portrayal of science and innovative technology can contribute to negative public attitudes (Costa-Font et al., 2008). Trust, linked to confidence and credibility, involves perceived risks, leading consumers to rely on expert opinions aligned with their values (Siegrist et al., 2000). Individual values, closely tied to trust, are essential for accepting biotechnology (Kim et al., 2018). Experts such as professors and scientists are deemed the most credible information sources on GMOs (Kim et al., 2018).

Trust gaps, reflecting differences in trust between competing institutional actors, are key predictors of attitudes toward biotechnological applications (Marques et al., 2014). Trust in regulatory bodies and scientists significantly influences attitudes toward genetic modification (Aliasgharzadeh et al., 2022). Building trust in scientists and regulatory institutions is crucial, especially when consumers lack information about gene technology (Aliasgharzadeh et al., 2022). Trust proves influential in U.S. consumers' attitudes toward GM foods, with government technology management identified as a critical determinant (Frewer et al., 2003).

Institutional trust has a greater impact on acceptance of genetically engineered foods than demographic factors and knowledge of GE crops (Hossain et al., 2004; Suldovsky & Akin, 2023). While many GMO-positive consumers trust the agricultural biotechnology industry, university research, and the government, those skeptical of gene-edited food exhibit greater trust in consumer and environmental organizations (Lindberg et al., 2023). Independent scientists and universities consistently emerge as the most trusted information sources, emphasizing the need for nuanced agricultural marketing communication strategies that align with varying levels of trust (Suldovsky & Akin, 2023). Recognizing these trust dynamics is crucial for tailoring communication efforts to diverse audience segments and encouraging informed public discourse on GMOs and agricultural biotechnology.

Knowledge

Knowledge also plays a pivotal role in shaping consumer attitudes toward GMOs and significantly influences agricultural marketing communication and media tactics (Aliasgharzadeh et al., 2022). Multifaceted consumer knowledge, encompassing objective and subjective dimensions, is integral in determining perceptions of benefits and risks associated with GM

technology and food (Hwang & Nam, 2021). While objective knowledge, rooted in accurate information, influences attitudes and purchase intentions, subjective knowledge, derived from direct experiences, indicates a sense of intimacy with products (Hwang & Nam, 2021).

Despite its importance, a significant portion of the American population reports limited exposure to information about foods that have been GM (Suldovsky & Akin, 2023). Media is crucial in distributing information, indirectly increasing knowledge, and influencing attitudes (Brossard & Shanahan, 2003). Recognizing the need to assess and improve consumer attitudes and knowledge about GM foods, researchers emphasize the importance of understanding baseline knowledge, perceived risks, and information needs for specific communication strategies that connect with consumers (Kim et al., 2018).

In situations of limited knowledge, particularly in developing countries, consumers may show high-risk perceptions and low acceptance of GM foods (Aliasgharzadeh et al., 2022). Bridging knowledge gaps becomes a focal point for educational efforts and communication strategies. For instance, Brosig and Bavorova's (2019) study in the Czech Republic revealed that while over 80% of respondents were aware of GM food, only 50% had a clear concept of the term, and most were not interested in the topic. This example emphasizes the fine line between bridging the knowledge gap and actively engaging consumers in the knowledge of genetic modification.

Another example of how knowledge influences consumer attitudes about GMOs includes results from nanotechnology studies among Canadian youth. The study reveals that science students tend to produce more positive attitudes toward technology compared to students enrolled in other subjects (Hekmat & Dawson, 2019). This shows the influence of educational backgrounds on attitudes toward emerging technologies.

As knowledge forms a cornerstone in shaping attitudes toward GMOs, agricultural marketing communication strategies should share accurate information, engaging consumers in an intellectual conversation that considers the intricacy between different dimensions of knowledge. The responsibility of disseminating accurate information by government agencies, farmers, and retailers is crucial in shaping public perceptions of GMOs, underscoring the need to understand knowledge dynamics for developing effective media tactics and communication strategies in the agricultural industry.

Moral and Ethical Concerns

Moral and ethical considerations significantly shape consumer attitudes towards genetically modified organisms, with technologies perceived as unsettling or interfering with nature often viewed as risky and immoral (Sjöberg, 2004; Aliasgharzadeh et al., 2022). The moral aspects of modern biotechnology play a crucial role in influencing public perceptions of GMO technology in food production, especially when perceived benefits from GMO foods are lacking (Aliasgharzadeh et al., 2022). Individual values often influence consumers' moral and ethical concerns about GMOs, with some actively evaluating risks and benefits based on their values (Sinemus & Egelhofer, 2007).

Trust and values are directly related to moral and ethical concerns, with stakeholders such as consumer organizations, environmental groups, and scientists considered more trustworthy than the biotech industry and government in the context of GM technology and ethical standards (Costa-Font et al., 2008). In the polarizing and ethical debate surrounding GM crops for sustainability, philosophical objections surface against genetic modifications that are perceived as inappropriate interference with the life of organisms (Evanega et al., 2022). This ethical

concern is heightened in developing countries, where large biotech companies wield influential power in determining the alteration of DNA in organisms, posing additional issues related to intellectual property rights, patents, and ownership (Xiao & Kerr, 2022; Abdul Aziz et al., 2022).

Feelings of fear or disgust towards modern agriculture practices, including GMOs, are closely tied to specific ideological or value choices, such as environmentalism, animal welfare, ecology, or a preference for tradition. Understanding consumers' underlying "food philosophy" is essential for comprehending the reasons behind their avoidance or rejection of specific food categories (Faccio et al., 2019). Differences in trust are closely associated with ethical concerns about genetically engineered foods and anti-technology orientations, with non-adopters perceiving them as high-risk and unethical. These concerns include apprehensions about the potential impact on the nation's food supply and the unequal distribution of benefits and risks within society (Lindberg et al., 2023). This underscores the interconnectedness of trust, values, ethical considerations, and the public's willingness to adopt or reject GMOs, emphasizing the need for effective communication strategies that consider diverse values and moral perspectives.

Influence of Marketing Communication on Consumer Attitudes

The Role of Media in Shaping Attitudes about GMOs

The influence of media on shaping public attitudes towards GMOs is a multifaceted phenomenon that spans many dimensions. Aliasgharzadeh et al. (2022) emphasize the importance of preventing biased information dissemination about GMOs on various platforms, as it can lead to distorted public perceptions. The study advocates for accurate, educational information from credible organizations to reduce consumer concerns, suggesting active communication strategies such as social media campaigns and educational programs. Similarly,

Kim et al. (2018) finds that despite safety information delivery by various sources, consumers remain concerned about GMOs, driven by a combination of risk misperception and poor understanding of plant breeding concepts. The study highlights the need for accurate information from credible sources, indicating consumer interest in insights from experts and non-governmental organizations (Kim et al., 2018).

Marques et al. (2014) provides another perspective, revealing a shift in public support for GMOs related to the media cycle. Media saturation in Australia, reflecting controversy, was associated with lower public support, indicating a potential negative impact on public attitudes. This means support for GM plants and animals for food tends to decrease during heightened media coverage about GMOs while experiencing an increase during periods of reduced media attention. This dynamic trend aligns with existing publicly available, peer-reviewed published scientific journal articles, such as the findings of Flipse and Osseweijer (2013) and Gaskell et al. (1999), who noted a negative association between increased press coverage of technological controversies and negative public attitudes.

The same study also reveals that individuals with higher trust levels in scientists exhibited a more positive attitude toward GM plants compared to GM animals for food (Marques et al., 2014). However, this effect was particularly pronounced in years of lower media coverage. These results are one example of trust's role in shaping public perceptions and suggest that media coverage intensity can affect trust's impact on attitudes toward different aspects of GMOs. These findings emphasize the correlation between media narratives, public trust, and evolving attitudes toward GMOs.

Rose et al. (2020) further emphasizes the role of media coverage and public attitudes toward GMOs. Although the effects of media attention are somewhat limited when considering

risk and benefit perceptions, media attention remains a common predictor of rejection or acceptance. The study suggests that media coverage is a source of informal learning about GMOs, influencing public perceptions and attitudes (Rose et al., 2020). Additionally, Siddiqui et al. (2022) highlights that a surplus of misleading information from the media contributes to consumer reluctance in purchasing GM foods. Consumers often rely on information from the government, experts, and family members to make seemingly informed decisions based on perception (Siddiqui et al., 2022).

Vilella-Vila et al. (2005) also points out the role of the media in shaping public understanding of biotechnology, indicating that most people learn about these topics through media. The media's representation of GM food has been suggested to influence consumer acceptance, possibly due to the emphasis on potential risks over benefits. The search for dramatic and often negative appeal in media stories may contribute to an anti-biotechnology bias, potentially exaggerating the risks of GM food (Vilella-Vila et al., 2005). For example, formulating GM agriculture as a symbol of progress and economic prospects could potentially result in more favorable public perceptions of biotechnology (Vilella-Vila, 2005). However, negative and exaggerated narratives of food produced using GM tend to be covered more heavily, therefore staying in the minds of consumers.

Overall, the literature underscores the intricate relationship between media portrayal, public perception, and attitudes toward GMOs, emphasizing the need for responsible information dissemination to ensure an informed and unbiased public opinion.

Role of Social Media in Shaping GMO Perceptions

In recent years, the role of social media in shaping perceptions of GMOs has become increasingly influential. States and regions across the United States are recognizing this shift and are integrating social media marketing efforts with agricultural branding programs to boost demand and sustain modern farming practices (Campbell & Bickle, 2017). The significant influence of online media on consumer attitudes toward GMOs is multifaceted. While online platforms can enhance consumer knowledge by delivering information rapidly, they also expose consumers to diverse and sometimes unreliable content. Consumers relying more on online media may shape their attitudes based on confusing, misleading, or inaccurate information (Hwang & Nam, 2021). This exposure to negative information further increases the likelihood of consumers overestimating their knowledge about GMOs and modern breeding methods in agriculture (Hwang & Nam, 2021).

The exponential growth of online media, including websites and social media platforms, has revolutionized the scope and vastness of the informational digital age. The transformative shift in marketing strategies includes embracing various channels such as farmers' markets, internet platforms, community-supported agriculture, and local food demand. These initiatives have positively impacted farms, aligning with the growing trend of retail grocery stores carrying more locally sourced and organic foods (Campbell & Bickle, 2017). It is also important to note that individuals who favor the positive aspects of GM tend to view science and technology more favorably and often get information about food risks and benefits from social media and government agencies (Lindberg et al., 2023). In navigating the evolving cycle of marketing communication tactics, understanding social media influences becomes crucial for preparing

effective strategies and informed decision-making for many people in the realm of GMO perceptions and agriculture.

Mass Media and its Impact on Public Attitudes Towards GMOs

Mass media also shapes public attitudes toward food produced using GM technology, acting as a vital social institution (Slack & Allor, 1983; Brossard & Shanahan, 2003). While it does not show a direct correlation between media use and fear of science, it does play a significant role in influencing authoritarian attitudes related to GMOs (Brossard & Shanahan, 2003). To alleviate dictatorial concerns, it is crucial to monitor information, prevent the spread of false data, and deliver accurate, educative content at understandable levels (Aliasgharzadeh et al., 2022).

The heterogeneity of information sources is a key factor influencing consumer attitudes toward GMOs. A diverse range of information channels decreases authoritarianism in science, emphasizing the importance of considering various media outlets when communicating information about agricultural biotechnology (Brossard & Shanahan, 2003). Furthermore, media indirectly yet significantly influences attitudes toward agricultural biotechnology by enhancing knowledge about the subject (Brossard & Shanahan, 2003). Individuals paying more attention to agricultural biotechnology in the media tend to be more knowledgeable, and increased knowledge correlates with decreased perceived risk in technology (Brossard & Shanahan, 2003).

Additionally, in a society seemingly filled with unlimited food choices, forming food identities is vital for self-identification and values (Faccio et al., 2019). The strategic targeting by supporters and opponents of new technologies, evident in pro-GM and anti-GM communication strategies, highlights the media's influential role in shaping public perceptions and underscores

the necessity for nuanced communication approaches across diverse information sources (Huffman et al., 2007).

Consumers' media dependency and inclination to seek GM food-related information are pivotal determinants of their knowledge levels (Hwang & Nam, 2021). Higher dependency on online media is associated with increased objective knowledge and confidence regarding GM foods, underlining the significance of educational efforts in addressing food safety risks (Hwang & Nam, 2021). The prevalent influence of mass media, particularly through news reports, broadcast programs, and documentaries, solidifies its position as a primary channel for shaping public attitudes toward genetically modified foods (Kim et al., 2018). The comprehensive nature of information acquisition, ranging from traditional mass media to diverse online platforms and interpersonal communication, highlights the intricate landscape of GMO-related knowledge dissemination (Siddiqui et al., 2022).

Importance of Strategic Brand Messaging for GMO's

In agricultural biotechnology, public perceptions and attitudes are intricately linked to individuals' levels of information, media exposure, and the diversity of information sources. Those with better-informed views on agricultural biotechnology and diverse information sources tend to have more positive attitudes toward public participation in science-related decision-making (Aliasgharzadeh et al., 2022). For example, recognizing the unique characteristics of the millennial demographic, which constitutes about 30% of the U.S. population, is paramount for effective brand messaging (Campbell & Bickle, 2017). Distinctive agriculture campaigns tailored to specific generations, particularly millennials, must incorporate

key themes like locally produced foods, utilizing social media to connect and convey meaningful brand messages (Campbell & Bickle, 2017).

Strategic branding campaigns for GMO products require specific approaches across demographic segments to foster meaningful connections. The traditional one-size-fits-all marketing strategy has evolved in the era of social media, prioritizing differentiated timing and messaging strategies that enhance consumer connection to products or services (Campbell & Bickle, 2017). The success of improved branding campaigns hinges on interaction with millennials, better access to certified products, offering free products or samples with brand logos, and conveying educated narratives that resonate with consumers (Campbell & Bickle, 2017).

In the broader context of public perception, the media's influence on GMO-related narratives is also important. Media tendencies to amplify celebrity viewpoints over scientific consensus and perpetuate misconceptions, such as associating GMOs with unnatural, harmful, or unhealthy attributes, play a pivotal role (Faccio et al., 2019; Hekmat & Dawson, 2019). Communication strategies must navigate the appropriate terminology surrounding biotechnology, recognizing that terms like "genetic modification" elicit more negative responses compared to the more neutral "biotechnology" (Suldovsky & Akin, 2023). Effective narratives in the media, framed positively to depict progress and economic prospects in GM agriculture, can potentially sway public perceptions and attitudes in a favorable direction (Vilella-Vila et al., 2005).

Relationships between Agricultural Marketing Communication and Consumer Attitudes

Impact of Trust Building in Agricultural Marketing Communication

Building trust is essential in agricultural marketing communication, especially when addressing public perceptions of uncertainties and risks associated with genetically modified (GM) crops. Public familiarity with uncertainty is considered, and effective risk communication requires understanding the diverse social representations of key issues between experts and non-experts (Gaskell et al., 1999). For example, in Europe, the low acceptance of GM foods can be attributed to a trust gap in institutions and authorities, highlighting the role of politicians in shaping informative and educative campaigns to address public concerns (Sinemus & Egelhofer, 2007). Trust is integral in conveying information about the positive societal and health effects of GM crops, emphasizing the importance of constant regulation, biosafety testing, and risk assessment by health authorities (Akinbo et al., 2021). While there is vigorous safety assessment, the call for scientifically sound, long-term studies is stressed to predict the potential adverse effects on human health (Abdul Aziz et al., 2022).

Trust-building efforts are influenced by public attitudes toward science, with a majority showing moderate to high scores on authoritarian attitudes (Brossard & Shanahan, 2003). Citizen political involvement is considered a means of building trust. However, it is noted that the general public may find agricultural biotechnology too technological to resonate with their everyday lives, indicating a potential lack of visible impact (Brossard & Shanahan, 2003). Trust and values are interconnected, with consumers' reactions to information dependent on their prior acceptance of GM food, emphasizing the need to align communication with values (Costa-Font et al., 2008). Scientific communication is suggested to adopt techniques and tones that align with the audience's neutral or aggressive position to effectively convey information (Faccio et al., 2019). For example, addressing the benefits of biotechnology in pest-management practices and

providing information to consumers can contribute to building trust in this technology (Heng et al., 2021).

Influence of Consumers on Marketing Effectiveness

Consumer perceptions and preferences significantly influence the effectiveness of marketing strategies, as observed in the case of Millennials' attitudes toward grocery chains and local foods. Despite initiatives by major retailers like Walmart and Kroger to emphasize their commitment to sourcing from local farmers, Millennials did not demonstrate awareness of these efforts in the study's discussions (Campbell & Bickle, 2017). This example suggests a potential disconnect between marketing messages and consumer perceptions within this demographic (Campbell & Bickle, 2017). Such findings highlight the importance of aligning marketing strategies with the specific values and preferences of the target consumer group.

Consumer trust is a critical factor influencing marketing effectiveness. Market research reveal that consumers in the US and the UK consider government and science as key players in controlling GM technology, indicating that trust in these institutions significantly influences attitudes toward GM technologies (Hossain et al., 2003; Hossain & Onyango, 2004). This shows the challenge of modifying consumer perceptions solely by emphasizing the benefits of GM food over conventionally produced food, especially when trust in institutions is lacking (Siegrist, 2000). Consumer willingness to pay a premium for non-GM food further emphasizes the higher value placed on non-GM products. European consumers are generally more inclined to pay higher premiums for non-GM foods than North Americans (Costa-Font et al., 2008).

The influence of consumers on marketing effectiveness is particularly evident in their purchasing behavior regarding GM food, which tends to be negative (Costa-Font et al., 2008).

Negative information associated with GM food notably impacts consumer behavior, emphasizing the need for marketing strategies that address and mitigate concerns. Additionally, gender, age, and knowledge contribute to shaping attitudes and purchasing decisions, further emphasizing the intricate relationship between consumer characteristics and marketing effectiveness in the context of genetically modified organisms (Costa-Font et al., 2008).

The Complexity of Attitude Change

Role of Emotions in Knowledge and Attitude Change for GMOs

The intricacies of attitude change involve complex psychological factors. Maslow's Hierarchy of Needs provides a framework for understanding human motivations, suggesting that as basic physiological needs are satisfied, individuals ascend the hierarchy to fulfill higher-level needs (Campbell & Bickle, 2017). In the context of food choices, intertwining cause-related social issues with branding can create emotional connections and elevate food from a basic necessity to a more meaningful aspect of self-awareness or community engagement (Campbell & Bickle, 2017). Aligning food choices with safety, social concerns, raising esteem, or self-actualization reflects the multifaceted nature of attitudes toward food and highlights the potential for emotional connections to drive attitude change (Campbell & Bickle, 2017).

Research further supports the role of emotions in shaping attitudes, emphasizing that attitudes become more positive when positive emotions increase and negative emotions decrease (Heddy et al., 2017). This shows the importance of emotional engagement in educational and communication strategies related to GMOs. Moreover, the emotional connection to animals, particularly livestock, plays a role in attitude formation. Humans tend to view animals as closer to themselves and, therefore, express more sympathy towards them compared to plants

(Kato-Nitta et al., 2021). This distinction has regulatory implications, with some countries establishing different regulations for gene-edited plants and animals, recognizing the emotional and ethical dimensions associated with each (Kato-Nitta et al., 2021). Understanding and leveraging these emotional dimensions is crucial in navigating the complexity of attitude change towards GMOs through agricultural marketing communication.

Challenges in Changing Pre-existing Attitudes towards GMOs

Effectively shifting pre-existing attitudes toward genetically modified organisms poses a substantial challenge. Frewer et al. (2003) and Lusk et al. (2004) emphasize the intricate relationship between people's attitudes, trust in information sources, and reactions to information about GMOs. The findings suggest that individuals who already favor genetic modification are more inclined to trust sources promoting its benefits, while those opposed to its development are likely to distrust the same sources, even when providing identical information.

According to Frewer et al. (2003), trust in information sources is driven by people's attitudes toward GMOs rather than trust influencing how individuals perceive risk. Meanwhile, Heddy et al. (2017) stress the importance of shifting attitudes toward GMOs, recognizing that altered attitudes can significantly influence how individuals seek and acquire knowledge in the future.

Addressing these challenges requires tailored communication strategies. Sleboda and Lagerkvist (2022) reveal that communicating with strong arguments specifically tailored to pre-existing views can lead to changes in both positive and negative initial attitudes toward GMO technology. This explains the need for precision in communication messaging that

recognizes and addresses individuals' pre-existing beliefs while emphasizing the importance of strong and informative arguments, especially on controversial topics like GMOs.

Strategies for Effective Agricultural Marketing Communication

Tailored Communication Approaches and Strategic Targeting of Specific Audiences

Traditional one-size-fits-all marketing approaches are insufficient and have been replaced by the need for tailored communication strategies that resonate with diverse demographic segments across multiple platforms. Lindberg et al. (2023) highlight the complexity of public perceptions, with 40-50% of Americans remaining undecided about how they feel about the use of GE methods and 33% finding them unacceptable. Tailored communication becomes crucial to cater to varying viewpoints and concerns, emphasizing the need to address specific aspects that influence public attitudes. Rose et al.'s (2020) study reinforces the significance of tailored communication by focusing on the rejection of GM foods, stressing the impact of public perceptions regarding the risks and benefits of GM technology. By understanding the concerns and priorities of a target audience, tailored communication can provide relevant information, alleviate fears, and highlight benefits, ultimately bridging the gap between diverse consumer perspectives and fostering understanding to influence more positive attitudes and acceptance toward GMOs.

Strategic targeting of specific audiences is crucial in successful agricultural marketing communication campaigns. Sinemus and Egelhofer (2007) emphasize the complexity of the public, which can be divided into specific subgroups based on factors such as values, wishes, fears, and cultural environments. Demographic characteristics also play a crucial role, as revealed by Aliasgharzadeh et al. (2022), where consumers' attitudes and behavioral intentions

toward GM foods can be influenced by age, gender, education, and economic status. Certain groups, such as elderly individuals or those with specific health concerns, may be particularly prone to poor awareness and knowledge of GM foods, making them strategic target groups for tailored communication and education (Kim et al., 2018). These insights continue to stress the urgency of strategic targeting and tailored communication approaches to effectively navigate the diverse nature of public attitudes towards GMOs.

Transparency in Communication Strategies Related to GMOs

Transparency plays a large role in shaping public attitudes and influences agricultural marketing tactics. The multifaceted nature of trust, which incorporates many dimensions like consumer interest, honesty, and competence, is intricately tied to the transparency of institutions and authorities involved in GMO food production (Aliasgharzadeh et al., 2022). One powerful strategy for transparent communication is labeling, providing consumers with crucial information to make informed choices and raise awareness about the benefits of GMO breeding technology (Costa-Font et al., 2008). While the impact of labeling on individual perceptions remains inconclusive, positive consumer experiences with GM products, particularly those demonstrating clear benefits, can positively influence attitudes (Grunert et al., 2003; Kiesel et al., 2005).

The ongoing debate between mandatory and voluntary labeling policies globally accentuates the delicate balance between consumer interests and industry costs in the GMO industry (Costa-Font et al., 2008). Mandatory labeling raises concerns about over-regulation and heightened industry costs. On the other hand, voluntary labeling, as observed in the US, allows companies to label their products but may limit consumers' access to comprehensive information

about the products they intend to purchase (Costa-Font et al., 2008). The tension between scientific recommendations and public opinion is evident in Europe, where labeling products if they have been GM is mandatory, reflecting the complex relationship between regulatory decisions, industry practices, and consumer preferences (Vilella-Vila, 2005).

In navigating this complex topic, transparent labeling practices are important in agricultural marketing communication campaigns. Providing consumers with credible information empowers individuals to make informed decisions (Siddiqui et al., 2022). Overall, transparency fosters trust, which is fundamental in developing positive attitudes toward GMOs and ensuring the success of agricultural marketing strategies in an environment where consumer awareness and scrutiny are increasingly prominent.

Importance of Educational Programs about GMO Technology

To increase knowledge and trust, educational programs are critical in shaping public perceptions and attitudes toward GMOs. Aliasgharzadeh et al. (2022) highlight the need for well-designed, active communication strategies, such as educational programs conducted through various channels like social media, workshops, school education, seminars, and media debates.

These initiatives aim to change public perceptions and attitudes about GM foods, encouraging a stronger connection between the public and institutions involved in GMO technology. Educational programs that focus on controversial science topics, like genetic engineering methods, are recognized as tools that teach conceptual change that can lead to shifts in knowledge and contribute to more positive attitudes and emotions (Heddy et al., 2017).

Increased education and knowledge can cultivate positive attitudes and enable individuals to make informed decisions about GMOs, even if countered with misinformation (Kim et al.,2018). It is important to recognize the impact of proper education in shifting individuals from a neutral stance towards GM foods to a more positive outlook when planning a campaign. Kim et al. (2018) also highlight the significance of educating younger individuals, who tend to be more flexible in their views, suggesting that a well-designed education program about GM food safety, providing exact information with clear evidence, may relieve anxieties and reduce opposition to GM foods. Rose et al. (2020) stress the importance of understanding how perceptions of risks and benefits influence attitudes, underscoring the role of education in informing future communication efforts regarding genetic engineering technologies. Additionally, Sinemus and Egelhofer (2007) advocate for a balanced approach in education, combining science-driven and emotionally-driven campaigns to communicate and inform the public about genetically engineered food effectively.

Implications

The research on genetically modified organisms offers significant implications for the relationship between agricultural marketing communication and consumer attitudes. Siddiqui et al. (2022) highlight the evolving issues of public perceptions, emphasizing the need for marketers to navigate the misconstrued views of GM methods and foods as unnatural. The economic challenges post-COVID-19 introduce a crucial element, as affordability becomes a key factor influencing consumer behavior and making GMOs more appealing. Marketers need to align strategies with scientific considerations and economic factors that resonate with changing consumer priorities.

Proactive communication strategies should prioritize emphasizing the benefits of GMOs rather than merely defending against perceived risks (Sinemus & Egelhofer, 2007). The findings caution against an imbalance in risk assessments, where communication tends to focus on risks, potentially underestimating the benefits. New communication strategies should prioritize credibility and knowledge by translating complex technical information into understandable language, engaging and target-oriented information delivery, and value-free reporting. Acknowledging consumer sovereignty, communication efforts should help consumers understand the relative seriousness of risks rather than inducing isolated sensations of hazard or outrage (Vilella-Vila, 2005).

The analysis of communication strategies reveals a need for a nuanced and adaptive approach. Sinemus and Egelhofer (2007) suggest that there is no standardized or perfect strategy, and cultural aspects must be considered, given their influence on public perception of new technologies. Additionally, Campbell and Bickle (2017) emphasize the importance of understanding and adapting strategies to the preferences of specific consumer subgroups.

Key points for an effective media communication strategy, as outlined by Costa-Font et al. (2008), highlight the importance of objectively informing the public about risks and benefits. Trustworthy sources and credible, persuasive information delivery are crucial elements. Communication campaigns should address characteristics of GM food that negatively influence consumer fears to prevent market constraints (Costa-Font et al., 2008).

Siddiqui et al. (2022) emphasize the importance of labeling and transparency in the GMO debate. High perceived risk necessitates scientifically objective education, making labeling and providing more information critical for building consumer trust. However, labeling alone is

insufficient, and a comprehensive communication effort is required to empower consumers with accurate information.

In building public trust in modern agriculture, Lindberg et al. (2023) advocate for collaborative governance involving institutions, scientists, ethicists, and consumer advocacy groups. Given the researched distrust, trust-building efforts should transcend government regulators and involve universities and advocacy groups in spreading accurate information. Trust in scientists, both industry and independent, is a critical factor influencing the impact of messages on beliefs toward GM crops (Suldovsky & Akin, 2023).

The implications emphasize the need for a comprehensive and adaptive approach in agricultural marketing communication. Marketers must consider economic factors, balance risk-benefit communication, adapt strategies to diverse consumer subgroups, and collaborate with various stakeholders to build trust, increase knowledge, and address ethical and moral concerns. The dynamic nature of public perceptions, economic considerations, and cultural influences necessitates an ongoing and adaptable communication strategy to shape positive consumer attitudes toward GMOs.

Limitations

One of the inherent limitations in researching the relationship between agricultural marketing communication and consumer attitudes toward genetically modified organisms is the vast scope of factors influencing consumer perceptions. The multitude of variables, including cultural, economic, and psychological factors, contributes to the complexity of the issue. As a result, capturing the entirety of consumer attitudes becomes challenging. Researchers may face

difficulty providing an exhaustive analysis due to the dynamic nature of consumer opinions influenced by evolving societal trends and external events.

Cultural and regional variations significantly influence consumer attitudes toward GMOs, which poses a substantial challenge in conducting a universally applicable study. Different cultures may have distinct values, beliefs, and preferences that shape their perceptions of GMOs. Additionally, regional variations in agricultural practices and familiarity with biotechnology can impact consumer attitudes. Consequently, generalizing findings across diverse cultural and regional contexts may oversimplify the intricate relationship between agricultural marketing communication and consumer attitudes.

While measuring trust and attitudes, crucial components of understanding consumer perspectives present challenges. For example, the study by Suldovsky and Akin (2023) reveals a backfire effect in communicating consensus among those with low trust in industry scientists. This highlights the complexity of trust dynamics and the potential for unintended consequences in communication efforts. As mentioned in the study, the phenomenon of psychological reactance further complicates the measurement of trust and attitudes.

Research methodologies used in studying the relationship between agricultural marketing communication and consumer attitudes may introduce biases that affect the validity of findings. The selection of samples, survey design, and data interpretation can inadvertently introduce bias, limiting the generalizability of results. Researchers must acknowledge these potential biases and aim to employ strict methodologies that minimize distortions in understanding consumer attitudes toward GMOs.

While investigating the relationship between agricultural marketing communication and consumer attitudes toward GMOs is essential, researchers must navigate these limitations to

provide comprehensive insights. Recognizing the scope constraints, cultural variations, challenges in measuring trust, and potential biases in research methodologies will contribute to a more accurate understanding of this complex relationship.

Proposed Future Directions and Areas for Future Research

As we advance our understanding of the intricate relationships between agricultural marketing communication strategies and consumer attitudes toward GMOs, several promising directions for future research appear. These areas address current knowledge gaps and anticipate the evolving dynamics of consumer perceptions and the impact of communication strategies.

Future research should closely monitor and analyze evolving consumer attitudes toward GMOs. This entails investigating how societal, cultural, and economic shifts influence public perceptions. Researchers should explore the impact of emerging issues, such as environmental sustainability, ethical considerations, and global health crises, on shaping consumer attitudes. Understanding the dynamics of these trends is crucial for designing effective and contextually relevant agricultural marketing communication strategies.

Next, the rapid evolution of media, including traditional outlets and social media platforms, plays a pivotal role in shaping public opinion. Future research should explore how specific media platforms influence consumer attitudes toward GMOs. This includes examining the role of influencers, the spread of information through online networks, and the potential for misinformation. Continuing learning about how different media channels contribute to forming consumer attitudes will help craft targeted and impactful communication strategies.

Investigating innovative and practical agricultural marketing strategies is also essential for staying ahead of the curve. Future research should explore the integration of new

technologies, such as augmented reality and virtual reality, in conveying information about GMOs. Additionally, understanding the effectiveness of personalized marketing approaches based on consumer demographics and psychographics can enhance the precision of communication strategies. Exploring the intersection of traditional and digital marketing channels in the agricultural sector is a promising area for future investigation.

Building on the insights provided by Suldovsky and Akin (2023), future research should deepen our understanding of trust dynamics by distinguishing between levels of trust in industry scientists and independent scientific experts. Investigating how these different sources of authority impact consumer perceptions and acceptance of GMOs can guide the development of targeted communication efforts. This approach will contribute to more effective strategies for communicating scientific consensus and building trust in the information given.

Future research endeavors should address current gaps in understanding the relationship between agricultural marketing communication and consumer attitudes toward GMOs and anticipate and respond to the dynamic nature of consumer preferences and communication. Exploring these proposed directions will undoubtedly contribute to a more comprehensive understanding of this complex relationship.

Conclusion

This study explores the complex relationship between agriculture, genetic modification, and public perception, which significantly influences the trajectory of human civilization. As agriculture evolves to meet the demands of a growing global population, the discourse surrounding genetically modified organisms stands at the crossroads of scientific advancement, public opinion, and awareness. The investigation into the critical question—What is the

relationship between agricultural marketing communication and consumer attitudes towards GMOs?—reveals key insights that shape our understanding of this dynamic relationship.

Key findings emphasize the pivotal role of agricultural marketing communication in significantly influencing consumer attitudes toward GMOs. This highlights the need for strategic and targeted communication approaches that go beyond scientific information to resonate with the public's values, knowledge, and needs. The societal choice regarding the acceptance or rejection of GMOs emerges as a nuanced decision shaped by a complex relationship of trust, consumer values, knowledge levels, ethical and moral concerns, and communication strategies.

Misperceptions about the safety of GMOs present substantial challenges to accurate communication, forming a need for targeted efforts that address public concerns. These efforts are crucial for fostering informed decision-making and overcoming barriers to acceptance rooted in misconceptions and misinformation. This study emphasizes the importance of continuous research as agriculture adapts to meet global challenges. As one of the world's largest and most significant industries, agriculture sustains life, fuels economies, and directly influences food security. In this context, understanding and shaping public perceptions of GMOs is vital for informed decision-making, responsible practices, and the overall sustainability of modern agriculture.

The relationship between agricultural marketing communication and consumer attitudes toward GMOs is not simply an academic inquiry but a critical exploration with extremely profound implications. It directs attention to the vital role of communication strategies in shaping public perceptions that guide the development of effective communication approaches that align with societal values. This ongoing research serves as a foundation for informed decision-making

among stakeholders and consumers, contributing to a comprehensive understanding of GMO acceptance in economic, environmental, and ethical dimensions.

Overall, this study contributes to a more refined understanding that bridges the gap between science, communication, and agriculture's indispensable role in shaping the trajectory of human civilization. The continued exploration of agricultural marketing communication and consumer attitudes towards GMOs is essential to ensure agriculture's overall effectiveness and align communication strategies with the evolving concerns and values of the global population.

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